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(54) Process for producing multilayer molded article.

(57) A multilayer molded article having a core layer (8) and a skin material (7) laminated on the core layer (8) is produced by providing a skin material (7) between a pair of upper (1) and lower (2) molds, supplying a thermoplastic resin melt (8) between the skin material (7) and one of the molds, closing the molds to press and form the resin melt while holding edges of the skin material (7) with pins (5) provided on a skin material-fixing (4) frame which moves along an outer peripheral wall of one of the upper (1) and lower (2) molds, and cooling the molds and removing the multilayer molded article from the molds.

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The present invention relates to a process for producing a multilayer molded article which comprises a core layer of a thermoplastic resin and a skin material which is laminated on the core layer.

A large number of plastic molded articles are used in many fields including the automobile and domestic electric appliance fields because of their low costs, free moldability and light weight. However, they have some drawbacks that they have poor appearance and cool feeling and they tend to be easily flawed. Then, it is highly desired to impart decoration and soft feeling to the plastic molded articles. Hitherto, many attempts have been made to provide a compound which satisfies such d sires. But, it is difficult to produce a resin molded article having improved surface properties with maintaining the free moldability and strength from a single material, and at present, multilayer molded articles comprising a combination of plural materials which have different functions are generally used.

Many processes are known for the production of a multilayer molded article. For example, JP-A-13859/1976 discloses a process comprising preforming a skin material by, for example, thermoforming, placing the preformed skin material in a mold, supplying a core resin melt and then integrating them together. This process requires many molding steps and apparatuses. In addition, since each apparatus and each molding method has its own technical problems, many works and expenses are necessary to produce a final product.

As disclosed in JP-B-19132/1975, another process molds a multilayer molded article using a single mold having a vacuum molding function and core resin supplying means. But, this process is no better than the above process.

To overcome the drawbacks of the above two processes, JP-A- 63461/1978 discloses a process comprising placing an unpreformed skin material in a mold and then integrating the skin material and the core resin. Though this process is economical, a tension of the skin material is controlled only in one direction and not in other directions, the skin material tends to be wrinkled, so that this process can produce only a simple shape article but not a deep drawn molded article.

As proposed in JP-B-24807/1988, a multilayer molded article can be produced by clamping edges of a skin material between a female mold and a skin material-fixing frame, preform the skin material, supplying a melt of a thermoplastic resin as a core material and then molding the resin. This process is not necessarily satisfactory for molding a large size article, in particular, having a complicated shape.

One object of the present invention is to provide a process for producing a multilayer molded article, which process solves the problems of the conventional molding processes.

Anoth r object of the present invention is to provide a process for producing a multilayer molded article having good appearance without wrinkles or breakage of the skin material.

A further object of the present invention is to provide a process for producing a multilayer molded article which process can simplify the production steps and produce the article economically.

According to the present invention, there is provided a process for producing a multilayer molded article comprising a core layer and a skin material laminated thereon, which process comprises steps of:

providing a skin material between a pair of upper and lower molds,

supplying a thermoplastic resin melt between said skin material and one of said molds,

closing the molds to press and form said resin melt while holding edges of said skin material with pins provided on a skin material-fixing frame which moves along an outer peripheral wall of one of said upper and lower molds, and

cooling said molds and removing said multilayer molded article from the molds.

Figs. 1A and 1B are vertical cross sectional views of an example of the molds used in the molding process of the present invention,

Fig. 2 is a plane view of an example of the skin material-fixing frame having pins according to the present invention,

Fig. 3 is a perspective view of an example of the multilayer molded article produced by the process of the present invention,

Figs. 4A and 4B are vertical cross sectional views of another example of the molds used in the molding process of the present invention, and

Fig. 5 is a plane view of another example of the skin material-fixing frame having pins according to the present invention.

Examples of the skin material to be used in the process of the present invention are woven or nonwoven fabric, a sheet or film of a thermoplastic resin (e.g. polyolefin, polyvinyl chloride, polyamide) and a thermoplastic elastomer (e.g. polyolefin type, polyester type, polyurethane type and polyvinyl chloride type thermoplastic elastomers). These skin materials may be used independently or in a form of a laminate of two or more of them. Further, the skin material may be lined with a foam sheet of polypropylene, polyethylene or polyurethane to impart soft feeling, or with a fabric or a sheet to protect the skin material from heat of the thermoplastic r sin melt or enhance adhesion between the skin material and the core layer. Before being placed in the mold, the skin material may be

preheated in order to adjust its tensile stress or elongation.

As the thermoplastic resin used as the core layer material, any one of conventional thermoplastic resins which are used in compression molding, injection molding and extrusion molding can be used. Specific examples are thermoplastic resins (e.g. polypropylene, polyethylene, polystyrene, acrylonitrile-styrene-butadiene copolymer, polyamide)

and thermoplastic elastomers (e.g. ethylene-propylene block copolymer, styrene-butadiene block copolymer).

The thermoplastic resin may contain at least one conventional additive, for example, a filler such as an inorganic filler and glass fiber; a pigment; a lubricant; and an antistatic agent.

In the process of the present invention, the skin material-fixing frame having pins is used, which frame moves along the peripheral wall of one of the upper and lower molds. The pins are provided on an upper or lower surface of the frame. Preferably, each pin has a diameter of 3 to 6 mm, and protrudes in a length of about 20 mm from the surface of the frame.

The skin material-fixing frame is provided around the upper or lower mold using expansion-contraction means such as a spring, an air cylinder or a hydraulic cylinder.

The skin material-fixing frame may be permanently or detachably connected to the expansion-contraction means. When the skin material-fixing frame is a detachable one, plural frames are used and, while one of them is used in the molding process, a skin material is set on one of other frames and immediately used in the next molding process, whereby a molding cycle is shortened.

The skin material may be set on the pins by piercing the skin material with the pins or by making small holes in the skin materials at positions corresponding to the positions of the pins and passing each pin through the corresponding hole.

Then, the thermoplastic resin is press molded by closing the molds while holding the edges of the skin material with the pins to produce the multilayer molded article having the laminated skin material thereon. Since a tension is applied on the skin material so that the skin material is cut by the pin from the pin position towards the center of the mold, an amount of the skin material which slides in the mold can be controlled by adjusting the diameter of each pin and a density of the pins so as to partly adjust a holding force of the skin material. When all the pins have the same diameter, at a part where the pin density is large, the holding force of the skin material is large so that the slid-in amount of the skin material is small, while at a part where the pin density is small, the holding force of the skin material is small so that the slid-in amount of the skin material is large.

For example, when the skin material is laminated all over a surface of a box-shape article, a part of the skin material at each corner tends to be wrinkled. To prevent such wrinkle at the corners, a larger number of the pins are provided at such parts to increase the holding force. If the skin material is torn or stretched excessively, the skin material is mounted on the pins in a slightly slacked state.

The pin with a large diameter provides a larger holding force than the pin with a small diameter, so that the slid-in amount of the skin material is reduced. Therefore, the slid-in amount of the skin material can be adjusted also by changing the pin diameter.

Since a part of the skin material held on the pin tends to be cut in the direction towards the center of the mold, each pin is preferably positioned outwardly apart from the mold part corresponding to the article edge by at least 10 mm. In view of workability when setting the skin material on the skin material-fixing frame and durability of the pins, a diameter of each pin is preferably from 3 mm to 6 mm.

The melt of the thermoplastic resin of the core layer may be supplied from a resin supplying apparatus which is provided outside the molds or through a conduit provided in either of the upper and lower molds. Preferably, the mold closing rate is adjusted at 30 mm/sec. or less, and the thermoplastic resin melt is supplied when the clearance between the upper and lower molds is from (C + 5) mm to (C + 100) mm wherein C is the clearance when the molding is finished. After the resin melt is supplied, the molds are further closed to the clearance of C mm, pressed for a predetermined time and cooled to obtain the desired multilayer molded article.

The present invention will be illustrated by the following Examples.

Example 1

To a pressing machine having a clamping force of 400 tons, a pair of molds which form an article of Fig. 3 were attached. The molds and the skin material-fixing frame were arranged as shown in Fig. 1. As shown in Fig. 2, the skin material-fixing frame had, on its upper surface, pins each having a diameter of 5 mm and a length of 20 mm at a distance of 230 mm on each side and at a distance of 50 mm on each corner.

As a skin material, was used an embossed polyvinyl chloride sheet lined with an expandable fabric having a total thickness of 0.7 mm (manufactured by Kyowa Leather Co., Ltd.). As a

thermoplastic resin, was used polypropylene containing 15 % of talc (Sumitomo Noblen BPZ 5077 manufactured by Sumitomo Chemical Co., Ltd.; Melt flow index of 40 g/10 min.). The upper and lower molds were maintained at 50 °C and 60 °C, respectively.

The skin material 7 was held on the skin material-fixing frame 4 by piercing the skin material 7 with the pins 5. The lower mold 2 was lifted up so as to contact the skin material-fixing frame 4 and the upper mold 1 through the skin material 7. When the lower mold was further lifted up, expansion means 6 was contracted by the lifting force of the lower mold so that the outer side wall of the upper mold 1 and the inner side wall of the lower mold 2 mated each other through the skin material 7 to form a closed cavity.

The lower mold was further lifted up. When the cavity clearance reached 50 mm, the lifting speed of the lower mold was decreased to 7 mm/min. and a thermoplastic resin which had been heated and molten at 220 °C was supplied between the skin material and the upper mold through a resin conduit 3 provided in the upper mold (Fig. 1A). The resin supply was stopped when the clearance reached 20 mm.

When the lower mold 2 was further lifted up, the molten resin was compressed and flowed with pressing the skin material 7 to the lower mold wall and expanding the skin material 7 to fill the mold cavity (Fig. 1B).

When the clearance reached 3.1 mm, the skin material-fixing frame 4 contacted to a horizontal part of the upper mold 1 and then the lifting up of the lower mold 2 was stopped. In this state, the molds were pressed and cooled for 40 seconds, and the lower mold 2 was lowered. Thereafter, the molded article was removed from the mold. The article consisted of the core layer having a thickness of 2.5 mm covered with the embossed skin material having no wrinkle or breakage.

Example 2

To a pressing machine having a clamping force of 400 tons, a pair of molds which mold an article of Fig. 3 were attached. The molds and the skin material-fixing frame were arranged as shown in Fig. 4. As shown in Fig. 5, the skin material-fixing frame had, on its upper surface, pins each having a diameter of 5 mm and a length of 20 mm at a distance of 230 mm on each side and at a distance of 50 mm on each corner. At a center of each side, a bar-passing hole 11 was formed.

As a skin material, was used an embossed polyvinyl chloride she t having a thickness of 0.5 mm lined with a polypropylene foam she t having a thickness of 3.0 mm (manufactured by Toray, an expansion ratio of 15). As a thermoplastic resin, was used polypropylene containing 15 % of talc (Sumitomo Noblen BPZ 5077 manufactured by Sumitomo Chemical Co., Ltd.; Melt flow index of 40 g/10 min.). The upper and lower molds were maintained at 20 °C and 30 °C, respectively.

The skin material 7 was held on the skin material-fixing frame 4 by piercing the skin material 7 with the pins 5. The upper mold 1 was lowered so as to contact the skin material-fixing frame 4 and the upper mold 1 through the skin material 7. When the upper mold was further lowered, expansion means 6 was contracted by the lowering force of the upper mold so that the outer side wall of the upper mold 1 and the inner side wall of the lower mold 2 mated each other through the skin material 7 to form a closed cavity.

The upper mold 1 was further lowered. When the cavity clearance reached 50 mm, the lowering speed of the upper mold was decreased to 7 mm/min. and a thermoplastic resin which had been heated and molten at 190 °C was supplied between the skin material and the lower mold through a resin conduit 3 provided in the lower mold (Fig. 4A). The resin supply was stopped when the clearance reached 20 mm.

When the upper mold 1 was further lowered, the molten resin was compressed and flowed with pressing the skin material 7 to the upper mold wall and expanding the skin material 7 to fill the mold cavity (Fig. 4B).

When the clearance reached 2.7 mm, the skin material-fixing frame 4 contacted to a horizontal part of the lower mold 2 and then the lowering of the lower mold 2 was stopped. In this state, the molds were pressed and cooled for 40 seconds, and the upper mold 1 was lifted up. Thereafter, the molded article was removed from the mold. The article consisted of the core layer having a thickness of 2.0 mm covered with the embossed skin material having no wrinkle or breakage.

Claims

1. A process for producing a multilayer molded article comprising a core layer and a skin material laminated thereon, which process comprises steps of:

providing a skin material between a pair of upper and lower molds,

supplying a thermoplastic resin melt between said skin material and one of said molds,

closing the molds to press and form said resin melt while holding edges of said skin material with pins provided on a skin material-fixing frame which moves along an outer peripheral wall of one of said upper and lower

molds, and

cooling said molds and removing said multilayer molded article from the molds.

2. The process according to claim 1, wherein each of said pins has a diameter of 3 to 6 mm and protrudes in a length of about 20 mm from a surface of said skin material-fixing frame.

3. The process according to claim 1, wherein said skin has holes at positions corresponding to positions of said pins and said pins are passed through the respective holes to set said skin material on said skin material-fixing frame.

4. The process according to claim 1, wherein each of said pins is positioned outwardly apart from the mold part corresponding to the article edge by at least 10 mm.

5. A multilayer molded article which is produced by a process as claimed in claim 1.

Fig. 1A

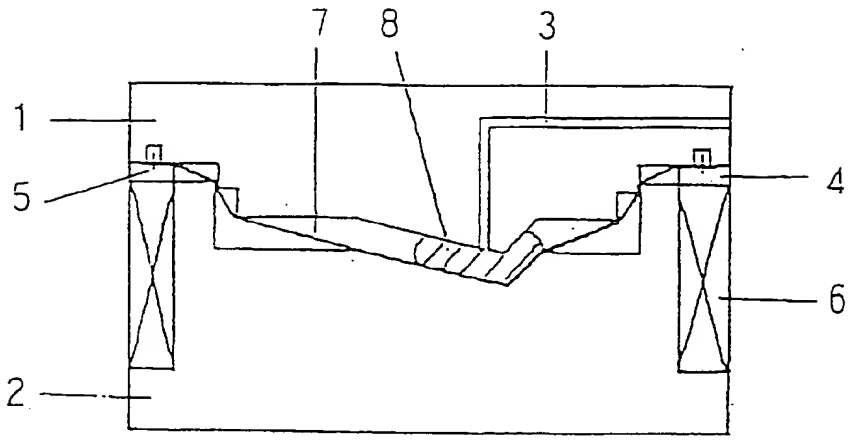


Fig. 1B

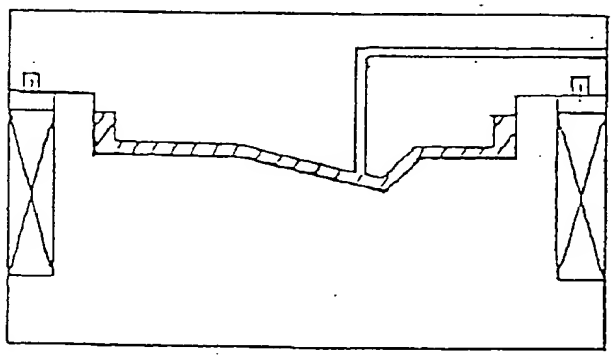


Fig. 2

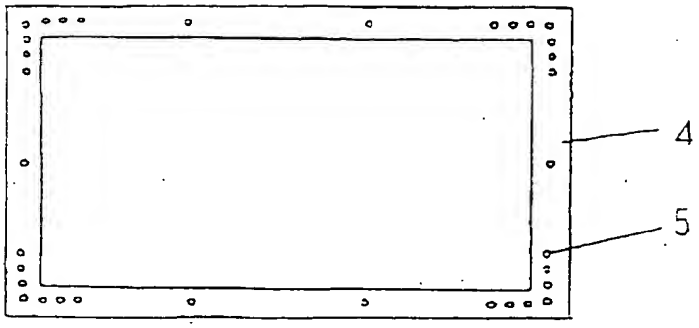


Fig. 3

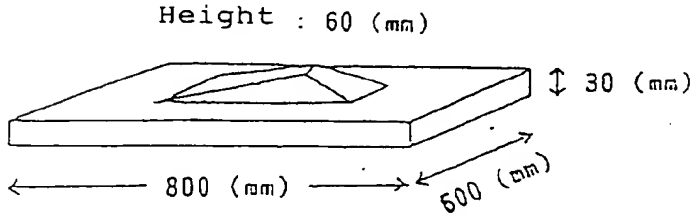


Fig. 5

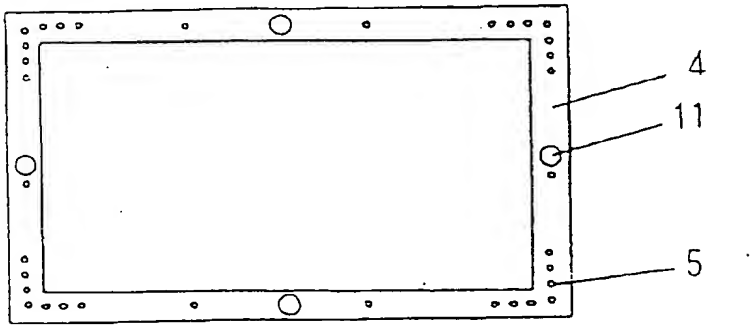


Fig. 4A

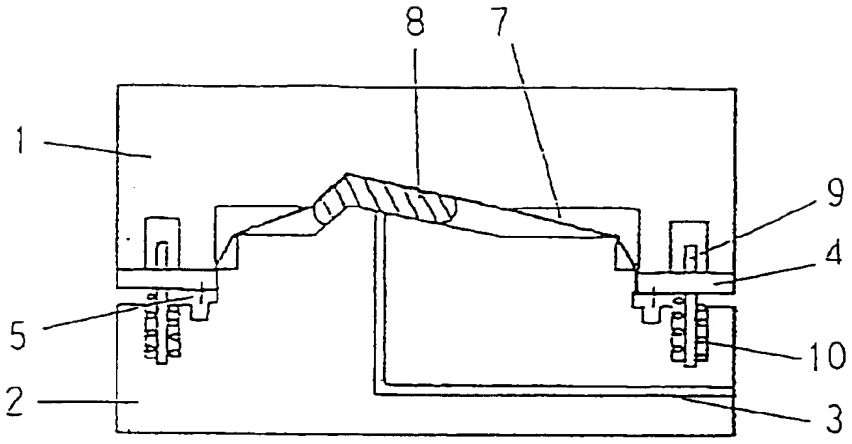
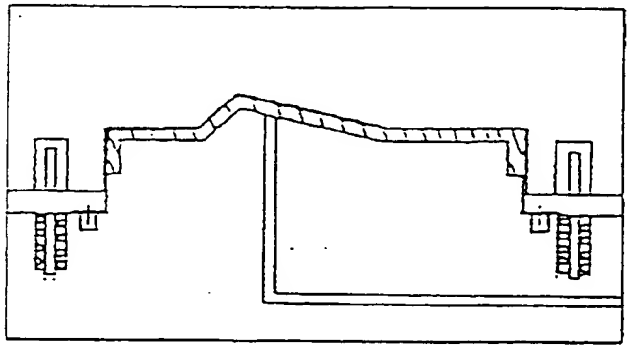


Fig. 4B



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EUROPEAN SEARCH REPORT

Application Number

EP 92 10 2657

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X A	EP-A-0 333 198 (SUMITOMO CHEMICAL COMPANY) * page 4, line 3 - line 7; claims 1,6; figures 1-4 *	1,2,4,5 3	B29C45/14 B29C45/56
X A	GB-A-1 143 199 (DESMA WERKE) * page 2, line 75 - line 93 * * page 3, line 31 - line 54; claims 1,5; figures 1,4,5,9 *	1,2,4,5 3	
A,D	FR-A-2 364 112 (IMPERIAL CHEMICAL INDUSTRIES)	1,2,4,5	
A	DE-C-833 118 (O. ZOLLFRANK) * page 2, line 76 - line 110; claims 1-4; figures 3,4 *	1,5	
A	FR-A-2 329 434 (FIRME FRIEDRICH THEYSOHN) * page 1, line 25 - line 39; claims 1,3,4; figures 1,2 *	1,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 MAY 1992	KOSICKI T.R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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